CLAIMS

1. A liquid crystal cell comprising:

a pair of substrates spaced adjacent to each other so as to create a cell gap, each substrate having a surface thereon;

a plurality of alignment domains disposed on the surface of at least one of the substrates, each alignment domain having an alignment direction; and

a liquid crystal medium disposed in the cell gap, wherein the liquid crystal medium assumes a twisted nematic liquid crystal arrangement that extends between the pair of substrates at a twist angle less than 90 degrees, and the alignment direction of at least one of the alignment domains is different than the alignment direction of at least one other of the alignment domains.

2. The liquid crystal cell of claim 1, wherein the twist angle is about 45 to about 85 degrees.

3. The liquid crystal cell of claim 1, wherein the twist angle is about 60 to about 85 degrees.

4. The liquid crystal cell of claim 1, wherein the twist angle is about 70 to about 80 degrees.

5. The liquid crystal cell of claim 1, wherein the alignment direction of each of the alignment domains is different than the alignment direction of each of the other alignment domains.

6. The liquid crystal cell of claim 1, wherein the plurality of alignment domains is four alignment domains.

7. The liquid crystal cell of claim 6, wherein the alignment direction of each of the four alignment domains is different than the alignment direction of each of the other three alignment domains.

8. The liquid crystal cell of claim 1, wherein the surface of at least one of the substrates is coated with an alignment film.

9. The liquid crystal cell of claim 1, wherein the alignment domains on at least one substrate are arranged in juxtaposition.

10. The liquid crystal cell of claim 9, wherein the alignment domains arranged in juxtaposition alternate between right-hand rotation and left-hand rotation.

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11. The liquid crystal cell of claim 1, wherein each substrate has a plurality of alignment domains, and the pair of substrates are spaced adjacent to each other such that the plurality of alignment domains on each of the substrates is offset from the plurality of alignment domains on the opposing substrate, whereby a liquid crystal cell having at least four alignment domains is formed.

12. The liquid crystal cell of claim 1, wherein each alignment domain has either twist distortion or splay distortion.

13. The liquid crystal cell of claim 12, wherein the alignment domains having twist distortion are arranged in juxtaposition, and the alignment domains having splay distortion are arranged in juxtaposition.

14. A liquid crystal display comprised of at least one liquid crystal cell of claim 1.

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15. A method of generating multi-directional alignment domains on a substrate, comprising the steps of:

positioning a particle source in a first position relative to the substrate, the particle source being capable of generating a particle beam;

positioning a mask between the particle source and the substrate;

directing the particle beam at the substrate, wherein the mask allows exposure of one or more selected regions of the substrate to the particle beam;

exposing at least a first region of the substrate to the particle beam, whereby at least one alignment domain having a first alignment direction is generated;

adjusting the position of the particle source relative to the substrate to at least a second position; and

exposing at least a second region of the substrate to the particle beam, whereby at least one alignment domain is generated having an alignment direction different than the first alignment direction.

16. The method of claim 15, wherein the mask is spaced a distance from the substrate.

17. The method claim 15, further comprising the step of rotating the substrate between the exposing steps.

18. The method of claim 17, wherein the step of rotating comprises rotating the substrate about 180 degrees.

19. The method of claim 15, wherein each of the alignment domains has an alignment direction that is different than each of the other alignment domains.

20. The method of claim 15, wherein four alignment domains are generated.

21. The method of claim 20, wherein each of the four alignment domains has an alignment direction that is different than each of the other three alignment domains.

22. The method of claim 15, wherein the step of adjusting the position of the particle source relative to the substrate comprises at least one of: adjusting the position of the particle source, adjusting the position of the substrate, and adjusting the position of the mask.

23. A method of producing a liquid crystal cell, comprising the steps of:

providing a first substrate and a second substrate;

generating multi-directional alignment domains on the first substrate by:

positioning a particle source in a first position relative to the first substrate, the particle source being capable of generating a particle beam;

positioning a mask between the particle source and the first substrate;

directing the particle beam at the first substrate, wherein the mask allows exposure of one or more selected regions of the first substrate to the particle beam;

exposing at least a first region of the first substrate to the particle beam, whereby at least one alignment domain having a first alignment direction is generated;

adjusting the position of the particle source relative to the first substrate to at least a second position; and

exposing at least a second region of the first substrate to the particle beam, whereby at least one alignment domain is generated having an alignment direction different than the first alignment direction;

generating at least one alignment direction on the second substrate;

spacing the first substrate and the second substrate adjacent each other so as to create a cell gap; and

inserting a liquid crystal medium in the cell gap.

24. The method of claim 23, wherein the liquid crystal medium assumes a twisted nematic liquid crystal arrangement that extends between the first substrate and the second substrate at a twist angle less than 90 degrees.

25. The method of claim 23, further comprising the step of incorporating the liquid crystal cell into a liquid crystal display.

26. The method of claim 23, wherein the step of adjusting the position of the particle source relative to the first substrate comprises at least one of: adjusting the position of the particle source, adjusting the position of the first substrate, and adjusting the position of the mask.

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27. A device for generating multi-directional alignment domains on a substrate surface, comprising:

an adjustable particle source capable of generating a particle beam, wherein the adjustable particle source can be rotated through multiple positions that correspond to desired alignment directions; and

a mask spaced a distance from the adjustable particle source, wherein the mask allows exposure of selected regions of the substrate surface to the particle beam.

28. The device of claim 25, wherein the mask is at least one of: attached to the adjustable particle source and attached to the substrate.

29. The device of claim 25, wherein the adjustable particle source has at least one fixed member and at least one adjustable member, and the particle beam is generated by the at least one adjustable member.

30. The device of claim 29, wherein the at least one adjustable member is a rotatable ion beam head.